

EFFECTS OF SOLAR ACTIVITY IN THE MIDDLE ATMOSPHERE
DYNAMICAL REGIME OVER EASTERN SIBERIA, USSRV.A.Gaidukov, E.S.Kazimirovsky, E.I.Zhovty,
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ABSTRACT: Lower thermospheric (90-120 km) wind data has been acquired by ground-based spaced-receiver method (HF, LF) near Irkutsk (52°N, 104°E). There is interrelated solar and meteorological control of lower thermosphere dynamics. Some features of solar control effects on the wind parameters are discussed.

The region 90-120 km is a part of the middle atmosphere. The response of wind regime of that region to solar and geomagnetic activity was revealed by numerous authors (KAZIMIROVSKY, 1985; LASTOVICKA, 1987). Our data of LF D1 wind measurements from 1975 to 1985 at D region of the ionosphere (frequency 200 kHz) and HF D1 wind measurements from 1972 to 1976 at E-region (vertical sounding, 2.2 MHz) gave the possibility for further investigations.

Statistical analysis of data for D-region (78 months) allowed us to conclude that there is a distinct relationship between monthly averaged prevailing winds (zonal and meridional) and solar activity. But we did not find such relationships for tidal components. The variations of zonal (V_{ox}) and meridional (V_{oy}) prevailing winds may be approximated in the following way:

$$\begin{aligned} V_{ox}(\mu, F) &= 17.1 + 3.9 \sin(\pi\mu/6) - 7.3 \cos(\pi\mu/6) + \\ &+ 4.4 \sin(\pi\mu/3) + 5.7 \cos(\pi\mu/3) + 5.4 F_{10.7}/100, \text{ m s}^{-1}; \\ V_{oy}(\mu, F) &= 5.4 - 1.8 \sin(\pi\mu/6) + 3.0 \cos(\pi\mu/6) - \\ &- 1.6 \sin(\pi\mu/3) + 3.7 \cos(\pi\mu/3) + 4.7 F_{10.7}/100, \text{ m s}^{-1}. \end{aligned} \quad (1)$$

Here μ is month number (for instance, January has number 1), $F_{10.7}$ - index of solar activity, the flux of solar radio-emission ($10^{-22} \text{ W m}^{-2} \text{ Hz}^{-1}$). This approximation is valid for $60 < F_{10.7} < 240$. As shown in Fig. 1, the correlation between prevailing winds and solar activity is rather positive. This result is in agreement with some recently published papers (ZHOVTY, 1984; KAZIMIROVSKY, 1985).

Some years ago we investigated the seasonal variations of the absolute differences between geomagnetically quiet and disturbed conditions for the parameters of D-region winds (KAZIMIROVSKY et al., 1986). Now we have done the same for E-region winds during 1972-1976. The solar activity decreased from $F_{10.7} \approx 100-150$ for 1972 to $F_{10.7} \approx 70-80$ for 1976.

Data obtained during periods with $K_p \leq 3$ were classed as quiet conditions, and those for $K_p > 3$ as disturbed conditions.

The seasonally averaged diurnal variations of wind velocity were approximated thus:

$$V_k(t) = V_{ok} + \sum_{n=1}^3 V_{nk} \cos\left[\frac{\pi n}{12}(t - t_{nk})\right], \quad (2)$$

$k = x, y$; t_{nk} - the phase of n -harmonics for the k -component of velocity. For each season we calculated the averaged differences:

$$\begin{aligned}\Delta V_{ok} &= | V_{ok}^q - V_{ok}^d |, \\ \Delta V_{nk} &= | V_{nk}^q - V_{nk}^d |,\end{aligned}\quad (3)$$

between quiet (q) and disturbed (d) conditions.

In most cases ΔV_{ok} and ΔV_{nk} increase with solar activity decreasing; therefore the stability of wind system increases with increasing solar activity. We know that the thermospheric neutral density correlates positively with solar activity. Possibly, this process affects the circulation and the influence of geomagnetic activity diminishes. At present we can only speculate about the suitable physical mechanism. But the lack of the definitive conclusions stresses the necessity of continuation of experimental researches of ionospheric motions.

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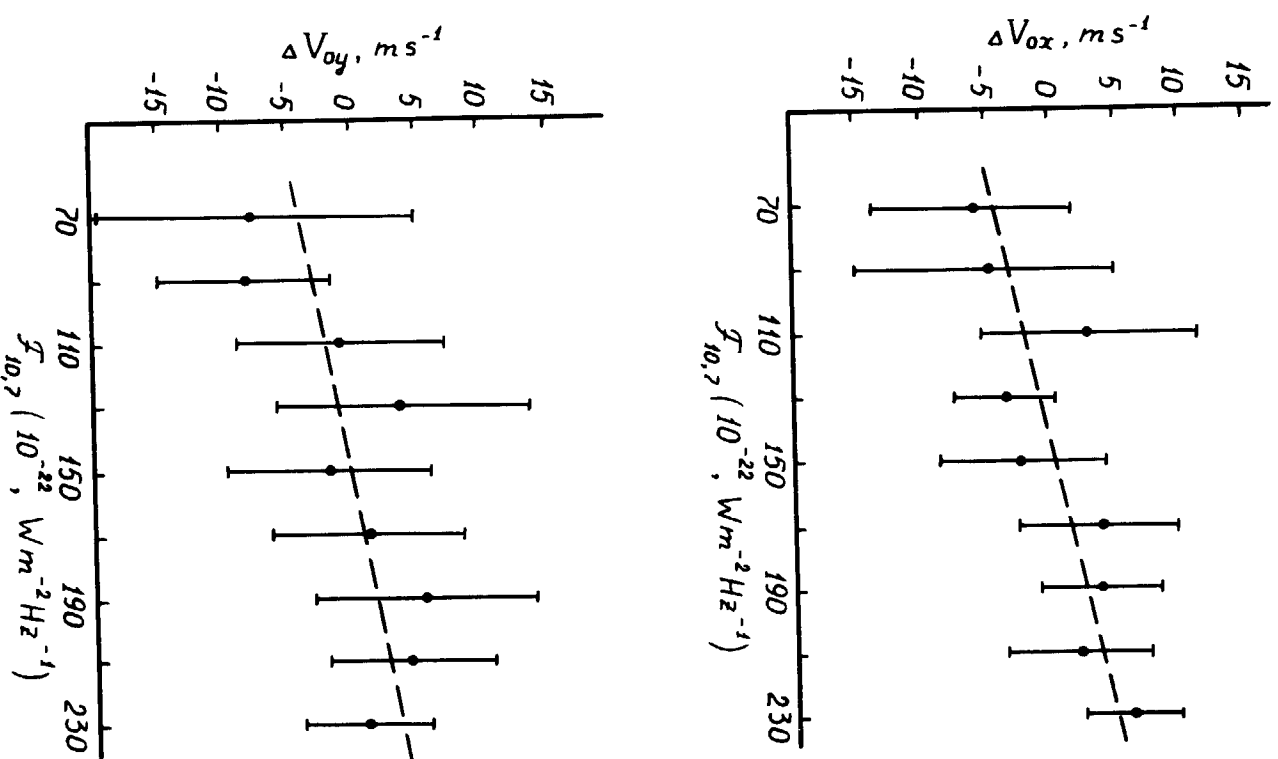


Figure 1. Dependence on solar activity ($10^7 \text{ cm}^2 \text{ radio flux}$) of the zonal (V_{ox}) and meridional (V_{oy}) prevailing winds at L-region over East Siberia for 1975-1985.

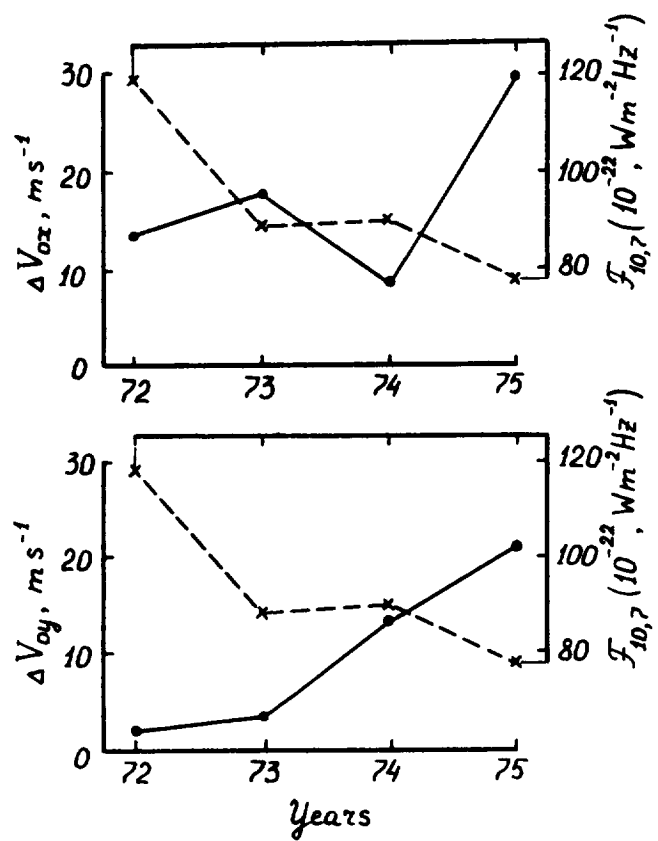


Figure 2. Seasonal averaged variation of ΔV_{ox} and ΔV_{oy} versus variation of $F_{10.7}$. (Autumn).